Communities Step Up to Challenges with Wireless Technology-based Strategies

The challenges communities face today don't have simple solutions. Deploying a community-wide wireless infrastructure opens options for new strategies for addressing these challenges. "Going wireless" offers many potential benefits for communities—from increased productivity to lower costs to greater citizen satisfaction—while being practical and cost-effective.

Metro-scale wireless broadband solutions bring community-wide benefits to Tempe, Xi'an, Portland and North-Rhine Westphalia—through support from Intel® Solution Services.

Making the Vision a Reality

Many communities have a clear vision of what they want their community to be. "A diverse, sustainable community with healthy neighborhoods, a vibrant urban core, a strong regional economy and quality jobs for all citizens" is how one U.S. city describes their vision. Wireless and mobile technologies can provide the foundation for strategies to achieve such a vision. Some benefits are:

Emergency workers can be better informed, enabling them to respond more quickly—saving lives and property. For example, ambulances can link instantly to the hospital, fire crews to hazardous materials databases and police cars to full records and photos. Wireless cameras can be used to monitor potential terrorist targets, high-traffic intersections and high-crime locations.

City government agencies can better serve their citizens and improve efficiency of services while decreasing costs.

- **E-Government.** *Citizens can access government services online, such as searching for a property deed, making a tax payment or renewing a fishing license. At the same time, governments can take advantage of new options for communicating with citizens and reducing costs.*
- **City Field Workers.** *Wireless mobile technology can play a significant role in increasing the efficiency of field workers. In-car connectivity allows officers to send intelligence to headquarters over the Internet and complete paperwork in the field for transmission to the station. Maintenance workers can file reports from the field, reducing the time spent completing paperwork at the office. On-site inspection results can be filed immediately from the site, reducing approval delays.*
- **Intelligent Transportation.** *Wireless tracking devices complement cellular and Global Positioning System (GPS) technology to enhance capabilities for monitoring public bus and subway locations and updating schedule information at boarding point kiosks. Traffic signal schedules can be remotely adjusted in the field based on traffic delays or emergency evacuation needs.*
- **Public Services.** *Deploying wireless devices, such as interactive kiosks and cameras, in public spaces and government buildings can reduce service costs—from security and traffic monitoring to parking fine payments to tourist support—while improving services.*

Businesses can be more competitive and profitable. A community-wide wireless infrastructure helps attract new businesses and support existing businesses. Community-wide wireless access brings expensive technologies within financial reach of smaller companies, reducing barriers to expanding their markets and lowering the costs of growing their business—making them better able to compete with larger businesses. A strong economy attracts and retains quality jobs and qualified people.

Schools and universities can better teach tomorrow's digitally literate workforce. Online information, resources and learning tools are more readily available to students with wireless access to the Internet; they can collaborate and share information with teachers and fellow students from anywhere at anytime. Providing affordable network services to under-served families helps address socio-economic gaps (often referred to as the "digital divide") between communities that have access to computers and those that do not.

Citizens are more satisfied with government services and their communities. Providing all residents with access to affordable network services opens a gateway to the information and computer skills they need to take advantage of the full range of educational and employment opportunities available today. A community-wide wireless network enables more flexible work models, such as telecommuting, that allow people to better balance personal lives and work. It helps create an environment in which everyone in the community can work and play more safely and effectively.

With more than 35 years of technology experience and an end-to-end commitment to the wireless industry, Intel Corporation has developed the knowledge and expertise to deliver next-generation wireless technologies designed specifically for mobile computing. Intel's professional services organization, Intel® Solution Services, can help communities fully understand the potential of their environment and provide the best solutions to meet their needs.

Familiar Challenges, New Options

The challenges communities face today—increasing productivity, lowering costs, bringing improved performance to business and government, and delivering greater citizen satisfaction—do not have simple solutions. However, deploying a community-wide wireless infrastructure opens options for new strategies for addressing these challenges, while meeting criteria set forth by stakeholders. A wireless network can:

- **Align with organizational business goals.** Many communities want to provide affordable access to all citizens while supporting viable strategies for long-term funding and support. Constrained budgets make it difficult to justify using taxpayer dollars to build and support a new network. Some cities are finding that partnering with the private sector is the answer. The city facilitates deployment of the network and then becomes an anchor tenant, while one or more commercial operators provide services and maintain the network.
- **Meet needs for community-wide network coverage and fast, secure connectivity.** Providing universal wired broadband service to everyone in a metro area is expensive. The cost of extending cables the "last mile" from a routing switch to individual homes and businesses can be prohibitively expensive, particularly in areas where the density of usage is low. A wireless network can be more cost effective and flexible. For example, a single wireless base station can cover a radius of 3 to 5 miles without the cost of deploying cables to provide last mile connections. Deploying wireless services is also more practical in rural towns that currently do not have access to broadband services.

  Recent developments in wireless standards led to the availability of strong encryption methods, highly secure authentication mechanisms, intelligent algorithms to reduce interference and data integrity protection. Fast, secure wireless connections can now be made available as a part of a standards-based wireless infrastructure deployment.
- **Provide powerful network performance and superior quality of service.** A wired broadband connection to the Internet provides excellent data transmission capabilities, but only for a user at a fixed location. Cellular services provide mobility but do not support the high bandwidth data transmission rate needed for rich media applications. Digital wireless solutions are providing a bridge for this gap.

  New standards for wireless implementations are now becoming available to support affordable, highly secure, high bandwidth service, as well as voice service, from fixed locations and will soon be available for mobile services. Quality of Service (QoS) is defined by these standards to ensure full integrity of data and near real-time voice transmission comparable to that provided by a land-line phone service.
- **Be scalable and compatible with legacy networks.** A wireless network infrastructure can be expanded quickly and inexpensively to scale the network to meet increasing demands. New equipment can be installed quickly and efficiently without the expense and time to dig trenches and run cables from one location to another. At the same time, wireless technologies can be fully integrated with existing wired networks to extend the capabilities of wired networks while preserving investments in wired technology.

Intel® Solution Services consultants can help define the best strategies for a community to develop an optimal wireless solution using standards-based technologies.

SEAMLESS ROAMING FOR COMMUNITY ACCESS

Wireless connectivity allows people to access the Internet with a device such as a laptop or personal digital assistant (PDA) without physically connecting it to a network with a cable. An end-to-end wireless solution is often based on the Wi-Fi and WiMAX standards and technologies described below.

Wi-Fi (short for "wireless fidelity") refers to a wireless local area network (WLAN) based on the IEEE 802.11* set of specifications. It is effective indoors and outdoors over a short distance of up to about 300 feet.

A Wi-Fi network enables a person with a Wi-Fi-enabled computer or PDA to connect to the Internet when in the proximity of an access point. An access point is the point of interconnection between the WLAN and a core network or Internet service provider's connection to the Internet. The geographical region covered by one or several access points is called a hotspot. Hotspots are typically found near restaurants, train stations, airports, cafes, libraries and other public places.

WiMAX (short for "Wireless Interoperability for Microwave Access") refers to a wireless metropolitan area network (MAN) based on the IEEE 802.16* specifications. A WiMAX network offers longer ranges—up to 30 miles—and greater transfer speeds than a Wi-Fi network. WiMAX provides a secure wireless network that can be deployed across metropolitan-sized areas using cost-effective, standards-based technologies. WiMAX and Wi-Fi technologies complement each other and are often used together in a community-wide wireless solution.

Backhaul refers to the technology used to get data from a Wi-Fi access point back to a core network or ISP's connection to the Internet. Last mile or last kilometer refers to the technology used to connect from the core network to a Wi-Fi access point. Wi-Fi networks can be deployed using high-gain antennas to provide backhaul and last-mile connectivity. However, WiMAX solutions that offer greater scalability and better QoS at a lower cost are now becoming available.

A number of Wi-Fi access points can be interconnected in a mesh configuration to provide a wider area of coverage called a hot zone. The scalability of a Wi-Fi mesh topology is limited by the expense of large numbers of cables and connections. WiMAX technology complements Wi-Fi mesh technology by eliminating the wires that connect the gateway mesh nodes to the core network and replacing them with affordable WiMAX customer premise equipment (CPE) that backhauls wirelessly to the core network. Using standards-based wireless technologies to *unwire* a community can reduce the total cost of network ownership and time to market while improving return on investment.

Outdoor wireless transmissions can easily be monitored using widely available and relatively inexpensive equipment. Strong encryption is essential if the privacy and integrity of transmitted information is to be protected. In addition, the use of firewalls, authentication, anti-virus software and intrusion detection systems (IDS) should be considered for mobile devices, such as laptops or PDAs.

Wireless Solutions Enhance Police Communication

A broadband wireless infrastructure offers solutions to two challenges faced by police officers in the field—immediate access to detailed data and dependable, high-quality, real-time communications within a department, between agencies and between jurisdictions.

Police departments often rely on proprietary trunk-based radio systems for communication in the field. Trunk-based radio systems typically provide connectivity using Cellular Digital Packet Data (CDPD) technology. Data rates are slow—no more than 19.2 Kbps—limiting data exchanges to text. With high-speed (1 Mbps or better) broadband wireless connectivity and a mobilized laptop or a handheld device, police officers can quickly access photos, drawings and audio or video clips, as well as written reports and data, from any location. For example, officers dispatched to a call could receive pertinent background data en route, such as weapons registered to an address or the prior call history of the complainant.

Police officers can file reports from the field using a handheld electronic notepad. Information is entered directly into the department's record management system, making it quickly available to anyone requiring access to it—while at the same time keeping the officer on the street rather than in the office filing paper reports.

CDPD technology-based police systems are offered by a variety of vendors. However, incompatibility between different vendor's systems often prevents police in two neighboring police jurisdictions—or even police and other emergency workers within a jurisdiction—from communicating wirelessly. A regional standards-based wireless infrastructure can enable cross-jurisdictional real-time communication and information sharing—securely and affordably.

A WiMAX-based metro-scale solution supports high-speed mobile access to multimedia data. WiMAX-compliant voice-over-IP (VoIP) technologies will provide secure voice communication with high priority connections assigned to police officers and emergency services. The first interoperable products are expected in the near future with full deployment of the WiMAX standard to follow soon after.

Making Wireless a Reality

Wireless technology and standards have developed to the point where end-to-end wireless networking on a city-wide scale has become practical and cost effective. Forward-thinking communities are now beginning to explore their options. To ensure success, they will need to:

- Identify opportunities for which wireless mobility can deliver immediate value.
- Begin with manageable pilot programs to validate benefits and refine solutions prior to wide-scale deployment.
- Take a cost-effective, phased approach to building a wireless infrastructure.
- Use standards-based technologies and certified products to provide a scalable solution that can grow as needs and technologies evolve, with particular emphasis on Wi-Fi and WiMAX certified products.

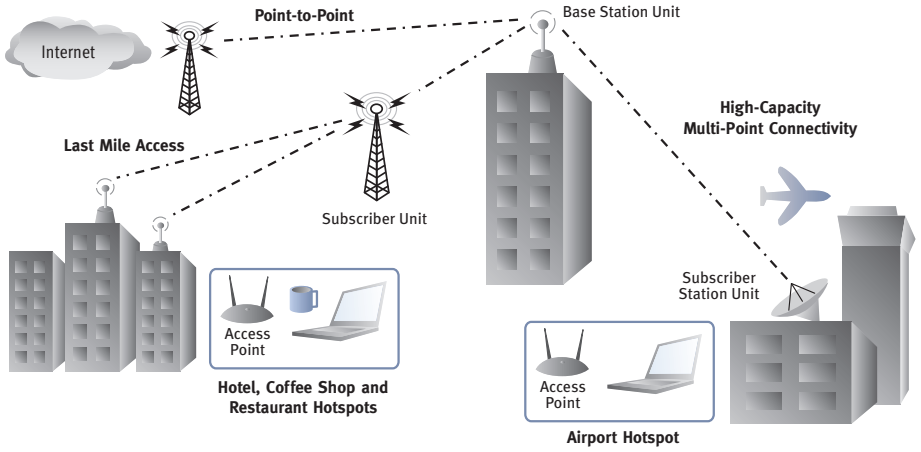
When it is time to deploy a wireless network, the municipal government IT department, or other responsible technical organization, will need to make critical choices about requirements to meet their network needs today and tomorrow. They will need to consider how to do this while controlling costs, reducing risk and speeding time to market. Arrangements will need to be made with incumbent Internet service providers (ISPs) and issues will need to be addressed related to state and local ordinances, codes and legislation.

Intel® Solution Services consultants can provide the expertise to help municipal IT departments develop a strategy for deploying a wireless network solution. As a part of their wireless infrastructure solution, they help evaluate vendors and service providers, products and solutions and provide guidance through the assessment, planning, design, deployment and verification phases of a project.

New Standards-based Technology Enhances Wireless Solutions

Individual vendors often develop complementary technology to enhance and support end-to-end wireless solutions.

IRAP framework pilot project. The Cloud, a United Kingdom (UK) company, is undertaking a project to provide secure, seamless Internet service at hotspots throughout Sweden. When they wanted to test a new network access architecture and International Roaming Access Protocols (IRAP) framework



A metro-scale wireless broadband solution.

in several Swedish railway stations, Intel® Solution Services helped them design, test and optimize the architecture. Intel Solution Services provided The Cloud with a proof-of-concept for their new access network solution architecture and an IRAP compliance assessment.

IRAP is a wireless network interface standard that allows the user to access the global Internet from compliant hotspots serviced by different service providers without acquiring credentials from each provider. A user can use the same login and authentication procedure at each hotspot and all charges are billed on a single invoice from that user's personal or business provider. IRAP also allows the user to access the wireless network with a higher security level than is available on a public Wi-Fi network.

The Cloud offers national wireless coverage in nearly 6,000 hotspot locations throughout the UK, Sweden and Germany. Service offerings include enterprise and corporate secure connections via public access points at a security level specified by the company. This service effectively expands the corporate wireless network out in the public for business people on the road.

Using the expertise of the Intel Solution Services consultants, municipal IT departments can create a roaming access strategy that works for them and get assistance in identifying potential partnerships when ready to implement their new networks.

Residential gateway proof of concept. DOVADO, a company headquartered in Dubai, United Arab Emirates, offers a portfolio of communications products with a focus on wireless broadband products. DOVADO asked Intel Solution Services to assist in testing their residential gateway product in a WiMAX network. A residential gateway, which serves as a central communication point in the home for services such as phone calls, TV, Web surfing and video-on-demand. WiMax provides a last-mile connection between a public wireless network and a wired or wireless network inside a home or business.

The testing was done using a wireless network operated by MobileCity in Skellefteå, a town in northern Sweden. Skellefteå provided an ideal venue for the testing as it is a wireless community and hub for research and development for wireless computer communications.

Intel Solution Services worked with DOVADO to rigorously examine the compatibility between the residential gateway and WiMAX technology for the delivery of voice services. The residential gateway provided full service and quality for VoIP traffic over the WiMAX network with calls routed and connected into GSM, 3G and standard fixed-line phone systems. The Intel Solution Services consultants provided network setup, voice quality verification and WiMAX optimization, using proven methodologies, tools, diagnostic software and comprehensive reporting.

SUPPORTING COMPONENTS OF A DIGITAL COMMUNITY

A variety of supporting technologies are used within a wireless infrastructure.

Mobile notebooks and handheld devices are designed for wireless mobility applications. In addition to notebook computers, tablets and similar form factors, wireless handheld devices, such as PDAs and cell phones, offer useful productivity advantages for many field workers. To be effective in the field, all devices must be reliable and easy to use, with a long battery life, substantial processing power, rich-media capabilities and a streamlined design. For example, laptops designed using Intel® Centrino™ mobile technology meet all these mobility requirements.

Mobilized applications enable seamless productivity as workers move between the office and the field. These interruptions need not disrupt productivity, as long as applications have been optimized for mobile use. In simple terms, applications should allow mobile workers to perform all their key functions, even when a network connection is not available. Reconnection and data synchronization should then be automatic, seamless and secure when the wireless signal is once again available.

Location-based services (LBS) present specific content, services and applications to a user, depending on the user's location. LBS can provide wireless access to local maps, street directions, restaurant and movie information, points of interest and contact information. Examples of LBS business applications include location sensitive billing, traffic updates, fleet management and asset tracking.

Streaming media is audio or video content that is transmitted on the Internet in a continuous or "streaming" fashion, so that it can be listened to or viewed as it downloads to the local device. Streaming media can be used in applications ranging from providing on-line training and workshops, to making video recordings of meetings and events available to the public, to presenting visual and audio information about local points of interest to tourists.

Communities Are Going "Wireless"

Local communities worldwide are making the move toward providing convenient and efficient wireless broadband communications to their citizens, businesses and municipal employees.

Arizona State University and Tempe, Arizona

In the southwestern United States, Arizona State University (ASU) is teaming with the City of Tempe to extend a campus-wide wireless network to provide wireless access into downtown Tempe. ASU wants to attract new students and enhance the learning experience of current students by offering superior facilities, services and tools. Tempe's goal is to extend the advantages of wireless access to businesses, government agencies and residents.

ASU and Tempe are undertaking this project in two phases. In the first phase, ASU designed and deployed a wireless network in downtown Tempe next to the main ASU campus. Easy wireless access encourages students and faculty to gather in off-campus coffee shops, restaurants and bookstores—helping generate revenue for local businesses while enabling students and faculty to collaborate more productively. Students can connect anywhere they have access to the wireless network to do research online, share information with other students and faculty members and retrieve homework assignments.

ASU is also working with the City of Tempe in a second phase, which started in early 2005, to expand the wireless infrastructure to the entire city through an open RFP process. This project will make affordable, high-quality, uninterrupted broadband wireless service available to all residents and businesses in Tempe.

ASU engaged Intel Solution Services as an independent, vendor-neutral party to review and assess an existing project design and deployment plan for downtown Tempe next to the ASU campus. The plan called for a Wi-Fi network with hotspots located throughout the area. The Intel team reviewed the overall project plan, verified bandwidth requirements, evaluated the network topology design, completed a physical inspection of proposed areas of coverage and conducted connectivity tests. They then presented their assessment and key recommendations for the wireless network design to the ASU project team.

Through its Intel® Technology Advisor Program, Intel® Solution Services is already collaborating with municipal governments and key technology alliances worldwide.

Xi'an Economic and Technological Development Zone

To encourage development in the inner continent (the "West") of China, the Chinese government developed a program for establishing privileged Development Zones that offer incentives, such as tax remissions, to attract multi-national and domestic companies to inland areas. Fifteen years ago, the city of Xi'an, located in the province of Shaanxi in northwest China, was a cultural and technical center with a number of universities and a highly educated work force. However, few alternatives were available locally for employment for its citizens—making it an ideal area in which to establish a Development Zone.

The Xi'an Economic and Technological Development Zone ("XDZ") was approved by the Chinese government in 1991 and provided with substantial seed funding for infrastructure development and marketing. Since then it has developed into one of the most successful economic and technological development zones in northwest China. It has attracted 5,600 firms to the area, of which 580 are foreign firms, and serves as an incubator and showcase for technology transfer. These firms are engaged in a wide variety of high-tech areas including electronics, information technology, optics, bio-medicine and software.

To make XDZ more attractive to local and foreign investment, XDZ has recently undertaken a project to turn the development zone into an advanced "e-Park." Key to this project is the development of a wireless infrastructure covering the entire development zone. Both internal staff and tenants will be able to securely communicate and access information from a PDA, laptop or cell phone from anywhere in the development zone.

"The Xian Hi-tech Industrial Development Zone is working closely with Intel® Solution Services to develop a wireless infrastructure for our region. The lowering of gross cost, coupled with an increase in efficiency and acceleration of information flow, are some of the benefits we're seeing by moving to wireless technology."

—Mr. Jing Jun Hai, Director of Xian Hi-tech Industries Development Zone, China

Companies today expect to be able to securely access business information, and communicate and collaborate with others in the office and on the road. By offering secure mobile services, XDZ will be able to more effectively differentiate themselves to enterprises seeking a new location in China.

Among the benefits for XDZ to implementing a campus-wide wireless infrastructure are:

- Mobile access to business applications and data
- Reduced maintenance costs
- Ease of scalability
- Increased efficiency and productivity
- More efficient team collaboration

XDZ commissioned Intel Solution Services to provide strategic consulting services to help them develop a method for identifying and characterizing problems and then to define goals and processes for reaching solutions. The internal network infrastructure uses Wi-Fi wireless technology to complement a wired network. Wireless access to the public portal is achieved using General Packet Radio Services (GPRS) and Wi-Fi technologies.

Unwire Portland Initiative

Portland, Oregon, a major metropolitan city in the northwestern U.S., is driving the development of a city-wide wireless network to provide leading-edge wireless communications technology at low cost to all citizens, schools, small businesses and local government agencies.

The project is being pursued through an innovative public-private partnership. The three main public partners—the city, the school district and the public transit service—expect to engage a private company to install and manage the network. This company would build the network by installing wireless equipment on partners' assets, such as street lamp posts, school roof tops or radio towers. The network would be open to service providers to provide retail services to the community. Competition between service providers will result in better service to end users.

The Portland Development Commission envisions a diverse, sustainable community with healthy neighborhoods, a vibrant urban core, a strong regional economy and quality jobs for all citizens. They want to make employees more efficient and offer cost-effective service to local businesses, city employees and consumers.

Inexpensive Internet connections available everywhere would attract new jobs, create new educational opportunities, keep small businesses competitive, generate administrative cost savings in both the public and private sectors and bring new economic opportunities to disadvantaged neighborhoods.

The City of Portland and the Portland Development Commission enlisted Intel Solution Services to assist in gathering requirements, analyzing deployment options, creating a database of assets, cataloging needs and usage models, facilitating the public contracting processes, and identifying appropriate suppliers for implementation. Intel Solution Services architected a conceptual design and is assisting the city in the creation of an RFP as they move toward implementing the city-wide wireless network.

The Digital North-Rhine Westphalia Project

To become a leading business region in Europe, the state of North-Rhine Westphalia (NRW) in western Germany is taking steps to transform its industrial-based economy into a knowledge-based economy. As one step toward this goal, NRW launched the digital NRW (dNRW) project, a public-private partnership focused on building an infrastructure to stimulate business growth.

To demonstrate how new technologies can be used to help make businesses more efficient and thus more competitive, the dNRW project initiated a pilot program demonstrating the potential benefits for mobile wireless technology. This project was undertaken at the Zollverein mine, a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage site in Essen, Germany.

For decades before it closed in 1986, the Zollverein mine was essential to the economy of the Ruhr area and its cities. Today it is a cultural attraction of national and international importance, attracting more than 120,000 visitors annually. Mobile wireless technologies enhance the tourist's experience, enable more efficient customer service and improve security at the Zollverein mine by providing:

- *A mobile tour guide for visitors.* A mobile, location-aware multimedia tour guide enhances the visitor experience by providing extensive information about the site through videos, drawings, photographs and text. Visitors access information specific to their current location, helping them better understand artifacts and exhibits.

Screen from Zollverein multi-media tour guide

- *Mobile visitor information for receptionists and visitors.* Visitors needing to know event schedules and directions frequently ask for information from service staff who happen to be passing by. A mobile visitor information support tool provides up-to-date information to staff and visitors at any location.
- *Mobile security for security guards.* Strategically placed wireless-enabled surveillance cameras monitor activities throughout the site, sending video images to a control center, where they are monitored and recorded. The system sends active-motion pictures to mobile devices carried by security guards, who can monitor activities remotely from wherever they are and respond quickly as an event happens. In addition to allowing flexible placement of cameras, this wireless solution eliminated installation and maintenance expenses related to wiring.

dNRW came to Intel Solution Services through the Intel® IT Innovation Centre for advice and guidance in how to design and develop a mobile solution for the Zollverein mine. Teaming with the consulting firm CapGemini, Intel Solution Services provided assessment, architecture design and development advice and participated in the development of the solution, which includes technologies such as Wi-Fi hotspots, location-based services, multimedia streaming and wireless surveillance cameras.

About Intel Corporation

For over 35 years, Intel Corporation has developed technology enabling the computer and Internet revolution that has changed the world. Intel introduced the world's first microprocessor in 1971 and today supplies the computing and communications industries with chips, boards, systems and software building blocks that are the "ingredients" of computers, servers and networking and communications products. Intel's mission is to do a great job for our customers, employees and stockholders by being the preeminent building block supplier to the worldwide digital economy. **www.intel.com**

About Intel® Solution Services

Intel Solution Services is Intel's worldwide professional services organization, helping communities around the world implement and manage new wireless initiatives. To help make wireless deployment a reality, Intel Solution Services consultants work with communities to:

- Assess goals and requirements through personalized workshops
- Recommend current and future standards-based wireless technologies using proven knowledge and experience
- Develop strategies for business models and short- and long-term network development
- Design and deploy comprehensive solutions using state-of-the-art design and testing facilities

Intel Solution Services consultants have end-to-end expertise in designing, building, implementing and optimizing solutions on Intel® architecture. The consultants are certified network, software, database and systems engineers and are experts in optimizing the efficiency of existing computing environments and implementing leading-edge technologies.

To learn more about how Intel Solution Services can help your community "go wireless" visit the Intel Solution Services Web site at **www.intel.com/go/intelsolutionservices**.

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